Upper Bounds and Density

Practice Worksheet (Jun 2023 Paper 2H Style)

I Do

A solid sphere has a radius of 2.8 cm (correct to 1 d.p.). The sphere has a mass of $M\pi$ grams, where $M = 260$ (correct to 2 s.f.).
Work out the upper bound for the density of the sphere. Give your answer in g/cm^3 correct to 2 decimal places. Show your working clearly.

We Do

A solid sphere has a radius of 3.4 cm (correct to 1 d.p.). The sphere has a mass of $M\pi$ grams, where $M = 420$ (correct to 2 s.f.).
Work out the upper bound for the density of the sphere. Give your answer in g/cm^3 correct to 2 decimal places. Show your working clearly.

You Do

A solid sphere has a radius of 4.2 cm (correct to 1 d.p.). The sphere has a mass of $M\pi$ grams, where $M = 680$ (correct to 2 s.f.).
Work out the upper bound for the density of the sphere. Give your answer in g/cm^3 correct to 2 decimal places. Show your working clearly.

Challenge

A solid sphere has a radius of 2.5 cm (correct to 1 d.p.). The sphere has a mass of $M\pi$ grams, where $M = 310$ (correct to 2 s.f.).
Work out the upper bound for the density of the sphere. Give your answer in g/cm^3 correct to 2 decimal places. Show your working clearly.

Answers

- **I Do:**
  $\text{Density} = \frac{M}{(4/3)r^3}$
  $\text{UB}_{\text{density}} = \frac{265}{(4/3)\times 2.75^3} = \mathbf{9.59}\,\text{g/cm}^\mathbf{3}$

- **We Do:**
  $\text{UB}_{\text{density}} = \frac{425}{(4/3)\times 3.35^3} = \mathbf{8.51}\,\text{g/cm}^\mathbf{3}$

- **You Do:**
  $\text{UB}_{\text{density}} = \frac{685}{(4/3)\times 4.15^3} = \mathbf{7.21}\,\text{g/cm}^\mathbf{3}$

- **Challenge:**
  $\text{UB}_{\text{density}} = \frac{315}{(4/3)\times 2.45^3} = \mathbf{16.15}\,\text{g/cm}^\mathbf{3}$